



# *DoD Science and Technology*

## Executive Forum on Modeling and Simulation

30 May 2001

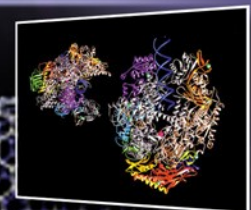
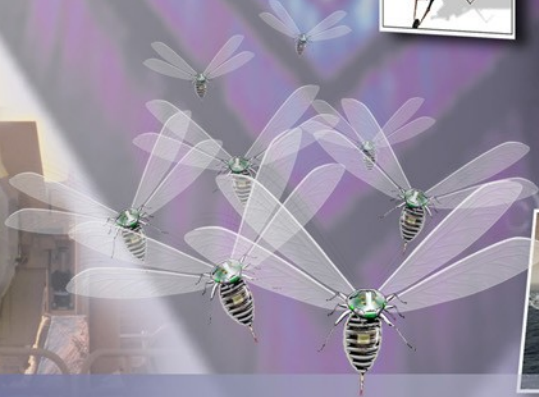
**Dr. Delores M. Etter**

**Deputy Under Secretary of Defense (Science & Technology)**

# Mission

*... to ensure  
that the warfighters  
today and tomorrow  
have superior and  
affordable technology  
to support their  
missions, and to give  
them revolutionary  
war-winning  
capabilities.*

Office of the Deputy Under Secretary of  
Defense for Science and Technology



# *Defense Science and Technology*





# *A Focus on Revolutionary Advances*

## *Stealth*



## *Adaptive Optics and Lasers*



## *GPS*



## *Night Vision*



## *Phased Array Radar*





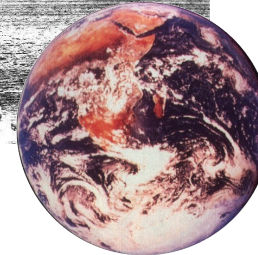


# Strategic Environment

## Global US Interests

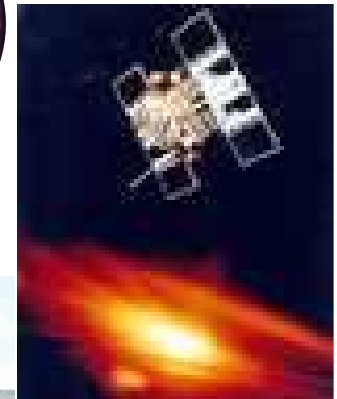
## Globalization of Technology

*Political - Economic - Humanitarian*



## Asymmetric Threats

*In any domain - Air, Land, Sea, Space or Information*







# FY01 RDT&E

**FY01 RDT&E = \$41.3B**  
**(6.1 thru 6.7)**

**(6.6 + 6.7 = \$15.6B)**

**Development**  
**(6.4 + 6.5 = \$16.7B)**

**Science and Technology**  
**(6.1 + 6.2 + 6.3 = \$9.0B)**

**21% of RDT&E**

**Technology Base**  
**(6.1 + 6.2 = \$5.0B)**

(\$B)

40  
36  
32  
28  
24  
20  
16  
12  
8  
4  
0

**6.7 Operational Systems Development (\$13.0B)**

**6.6 RDT&E Management Support (\$2.6B)**

**6.5 Engineering and Manufacturing Development (\$8.8B)**

**6.4 Demonstration and Validation (\$7.9B)**

**6.3 Advanced Technology Development (\$4.0B)**

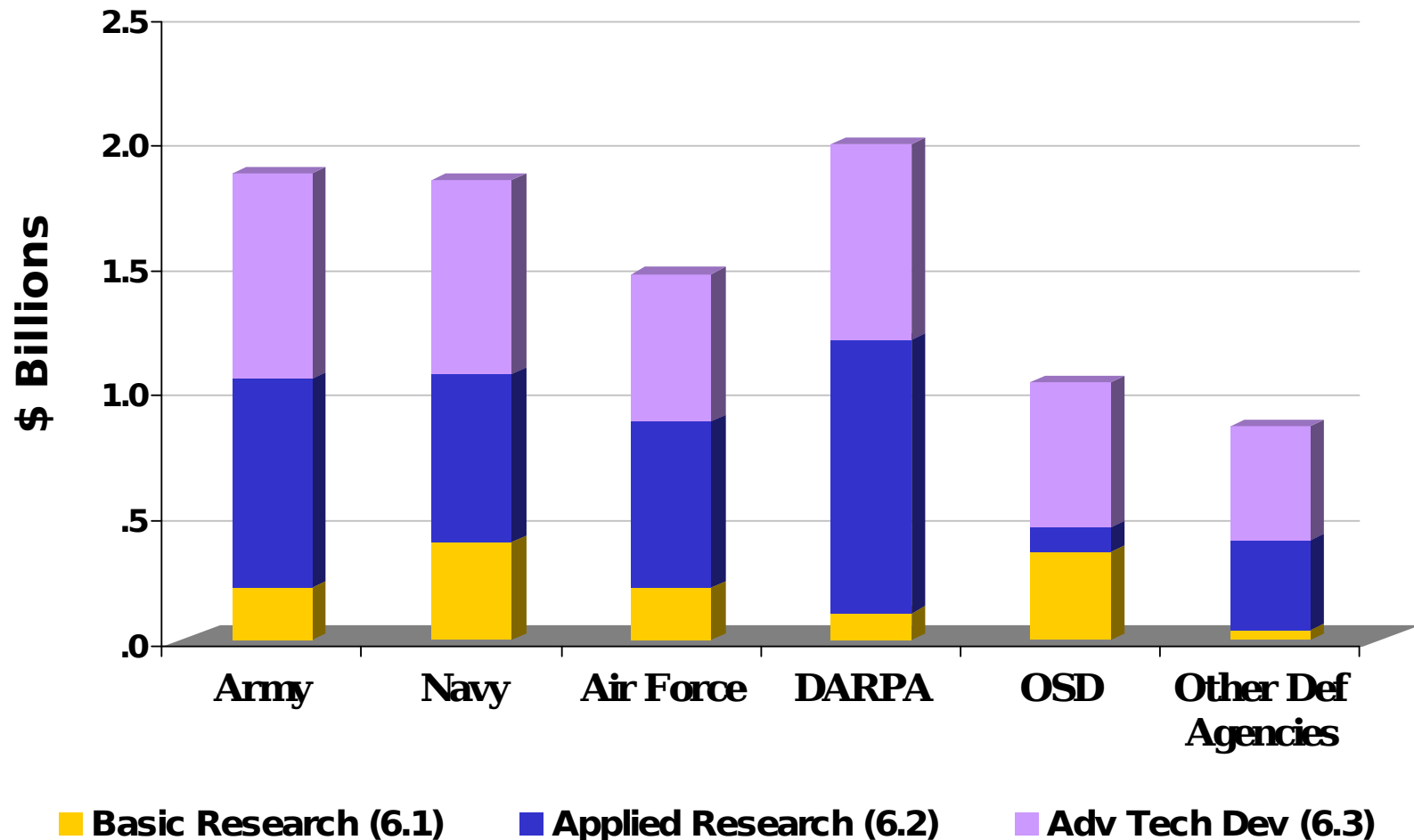
**6.2 Applied Research (\$3.0B)**

**6.1 Basic Research (\$1.3B)**



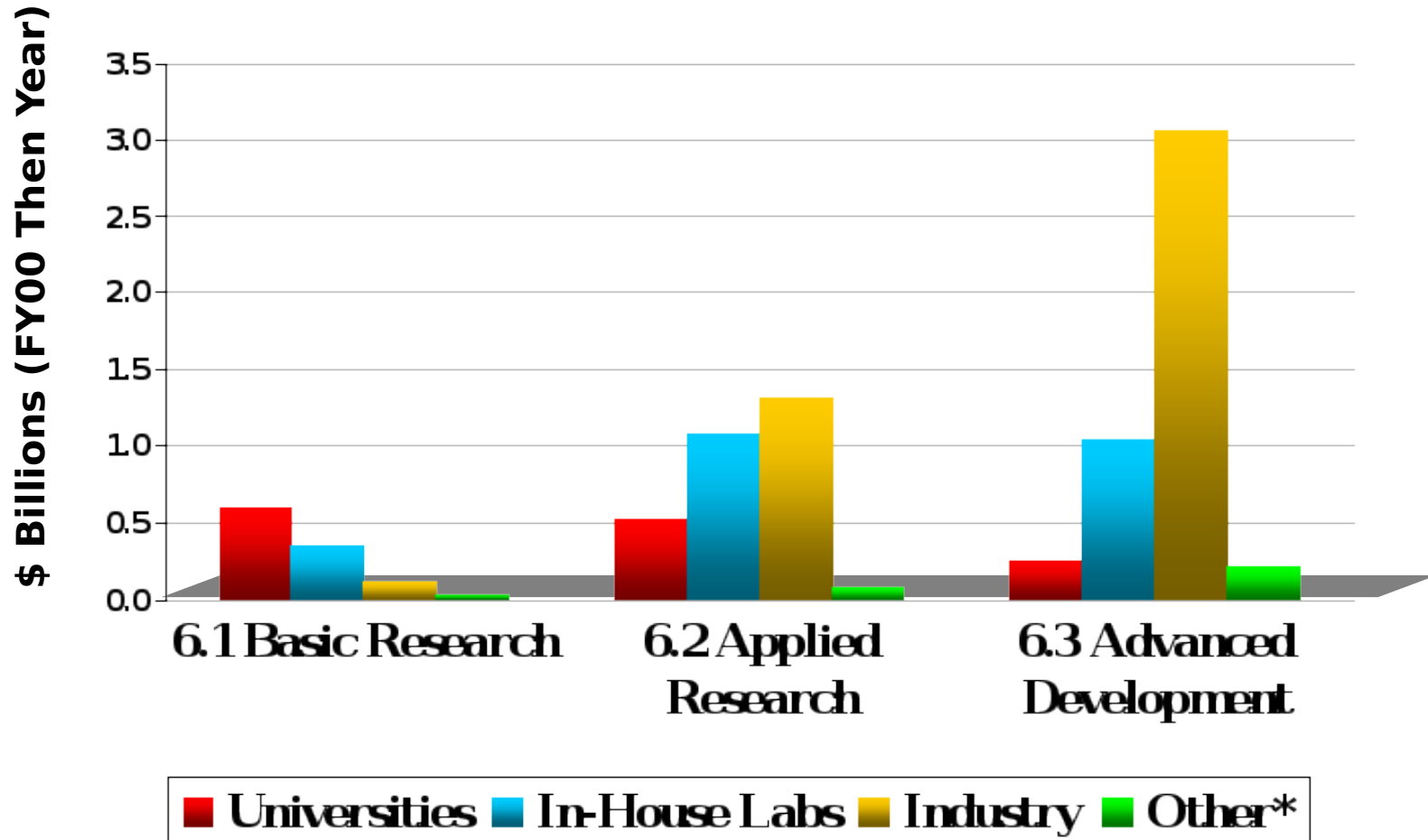
# DoD S&T Investment

***Total FY01 S&T = \$9.0B***





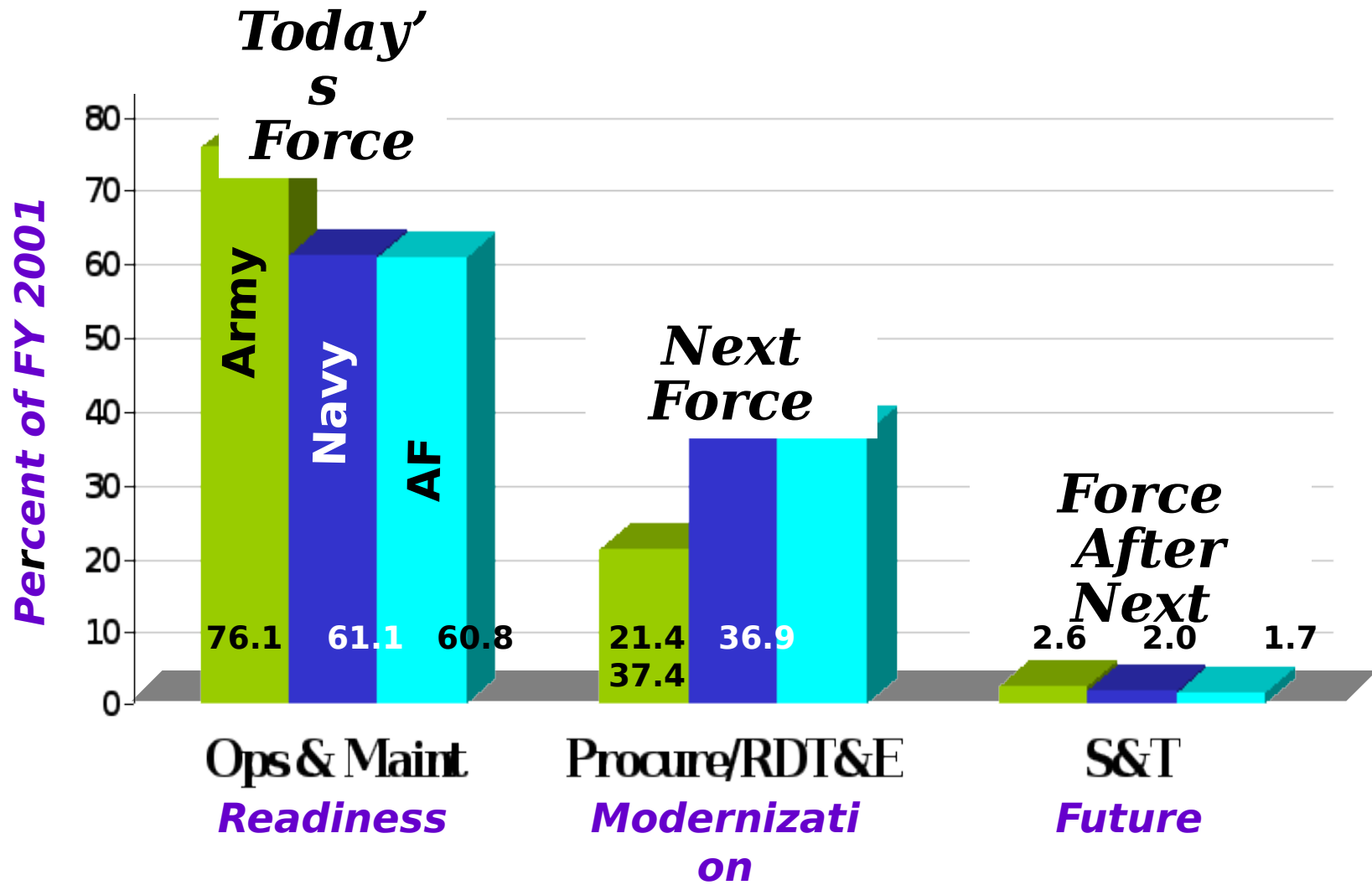
# Recipients of DoD S&T Funds



**\*Includes non-profit institutions, State & local govt., & foreign institutions**

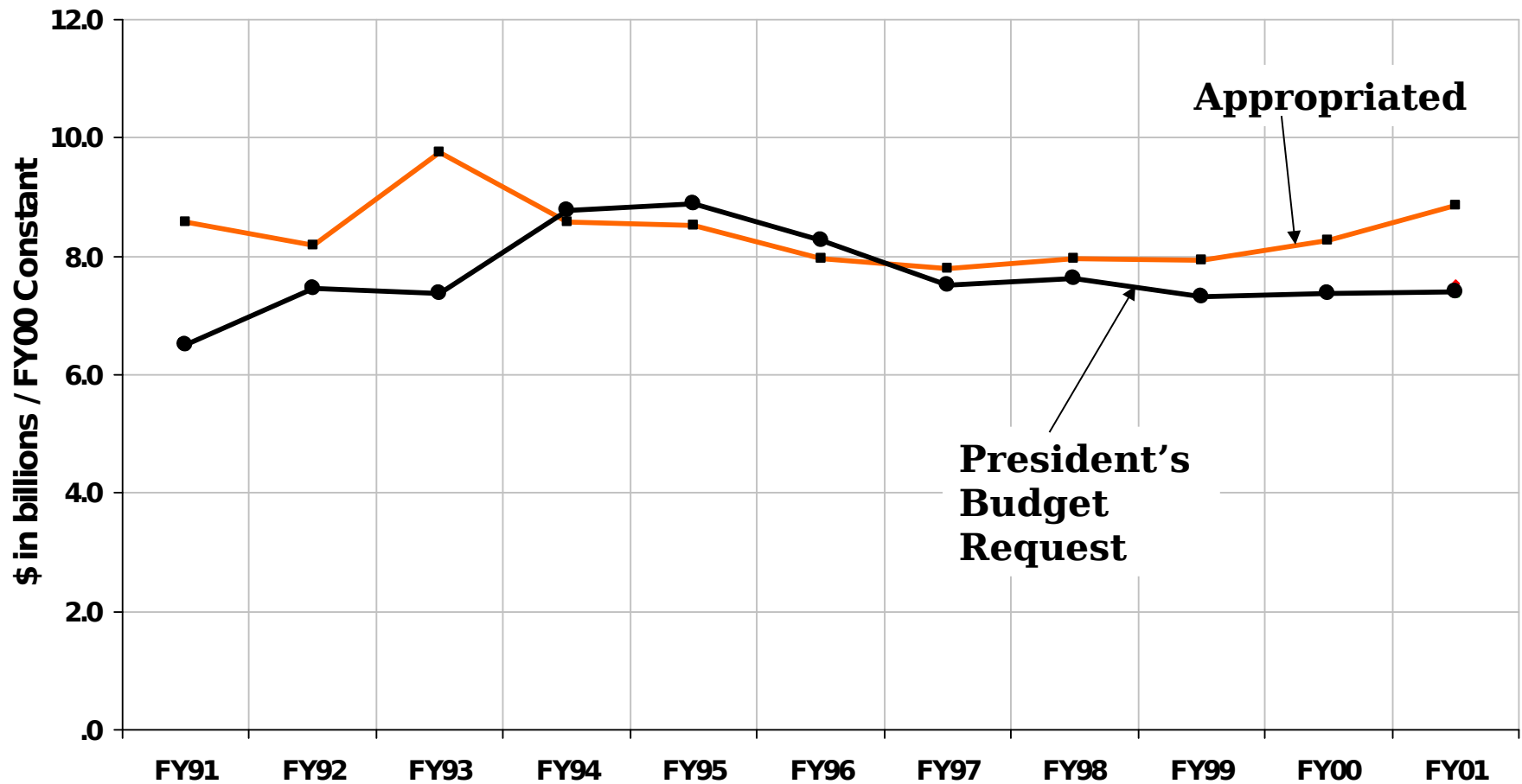
Source: National Science Foundation Report Volume 48 (FY 2000)

# Technology Perspectives FY01





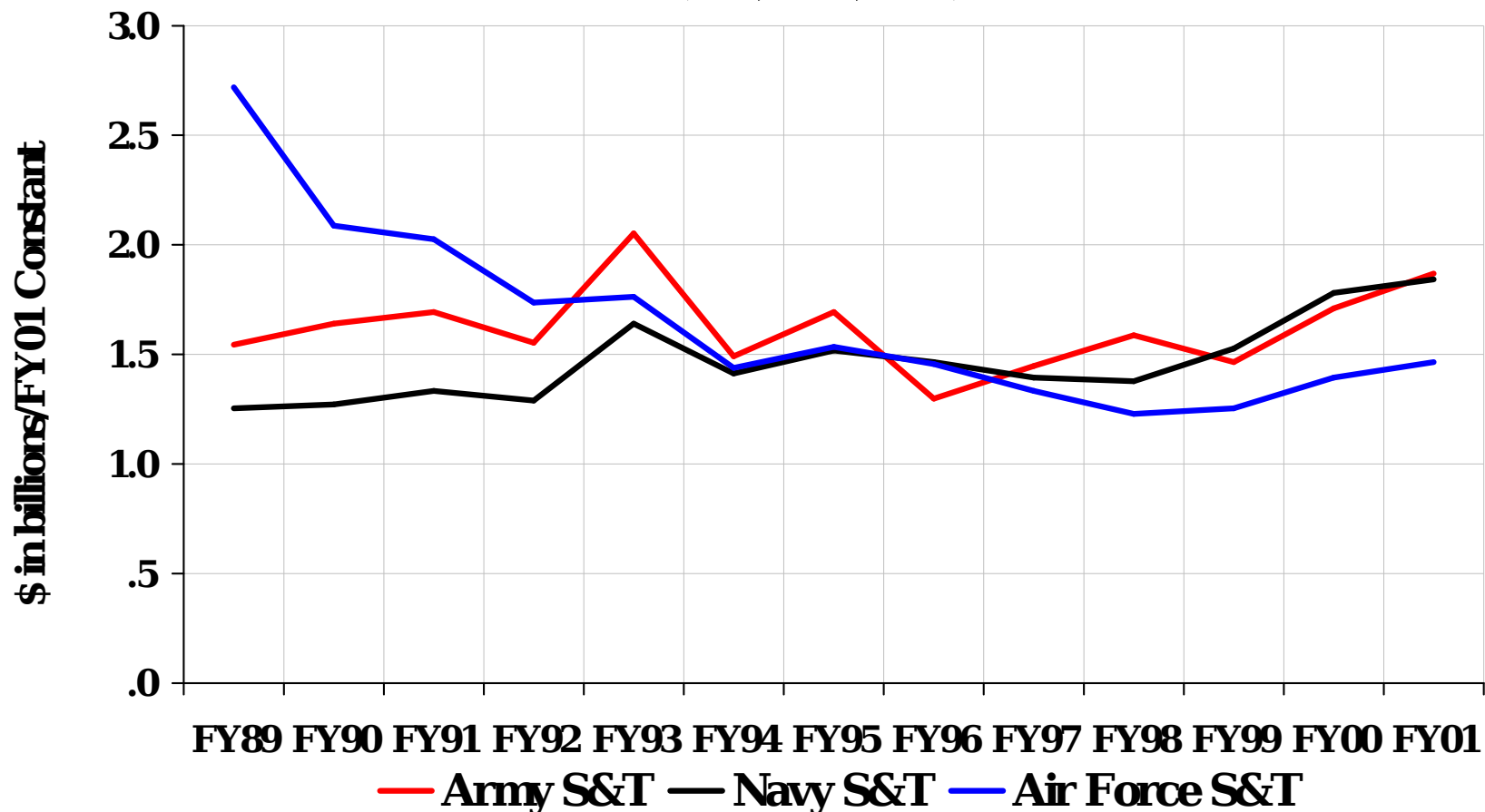
# Department of Defense Science & Technology (S&T)



# Service Investment in Science & Technology



## Services Science & Technology (S&T) (6.1, 6.2, 6.3)





# DUSD (S&T) Priorities 2001

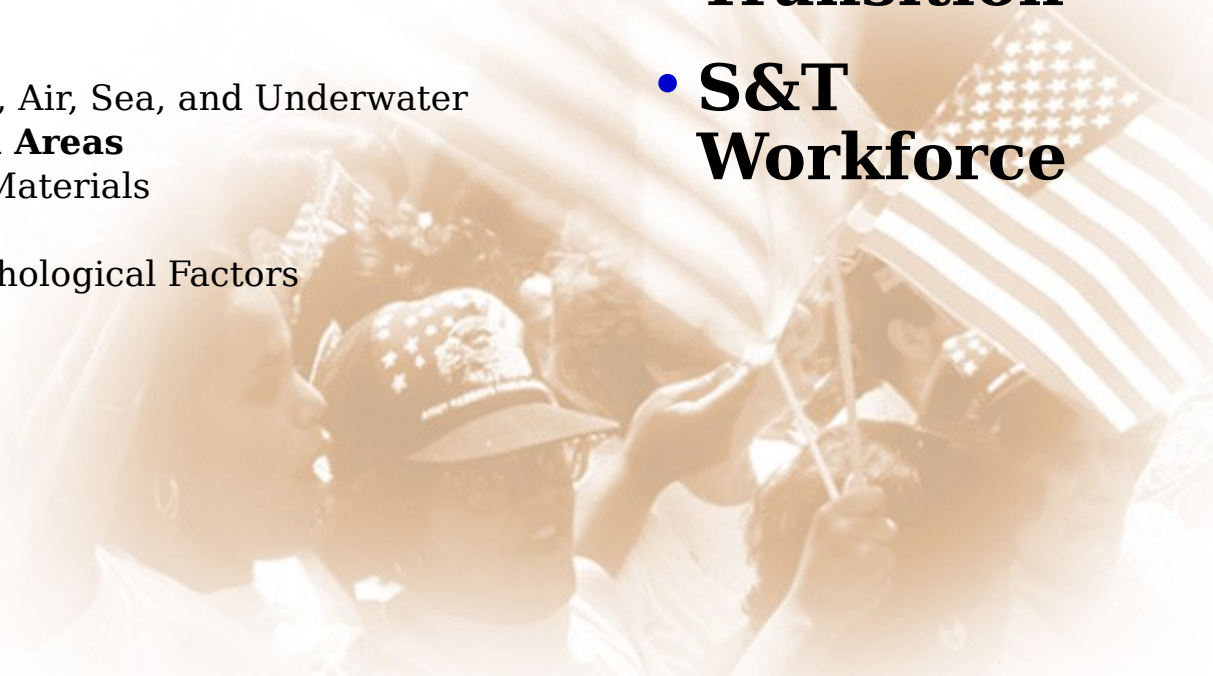


## *Technical*

- **Basic Research**
- **Strategic Initiatives**
  - **Hard Problems**
    - Time Critical, Standoff and Concealed Target Defeat
    - Cruise and Ballistic Missile Defense
    - Chem-Bio Defense Modeling and Stand-off Detection
    - Military Operations in Urban Terrain
    - Counters to Asymmetrical Threats
  - **Revolutionary Warfighting Concepts**
    - Fuller Dominance of Space
    - Network Centric Warfare
    - Unmanned Systems for Land, Air, Sea, and Underwater
  - **Military Significant Research Areas**
    - Nanoscience and Advanced Materials
    - Advanced Power
    - Human Dimensions and Psychological Factors
    - Directed Energy

## *Non-Technical*

- **Funding Stability**
- **Technology Transition**
- **S&T Workforce**



# Basic Research



**Microsatellites**



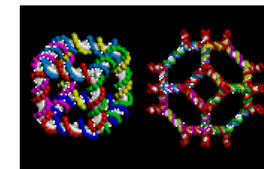
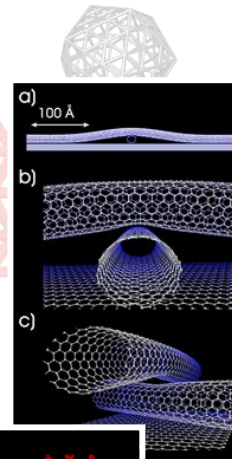
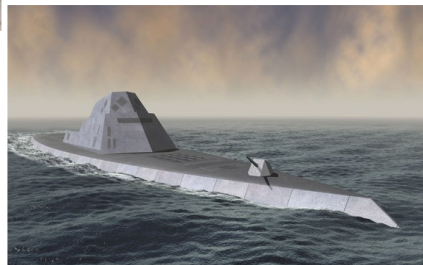
**Joint Strike Fighter**

**Micro Air Vehicles**



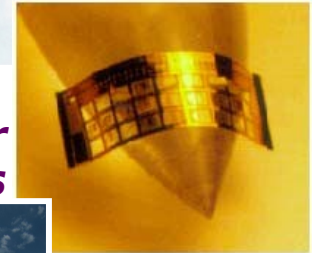
**Micro Robots**

**DD-21**



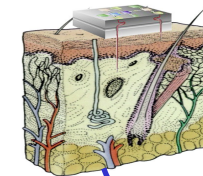
**Nanotechnology**

**Flexible Sensor Skins**

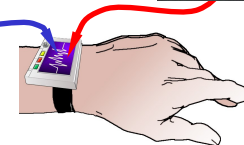


**Augmented Reality**

**Bio Sensors**



**Embedded Biofluidic Chips**

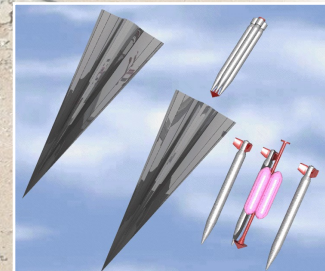
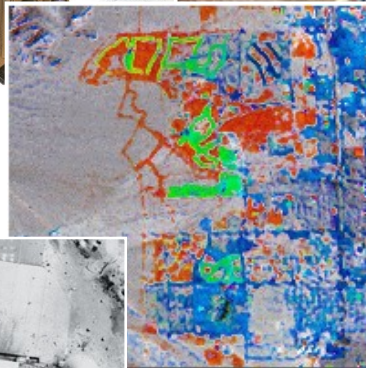
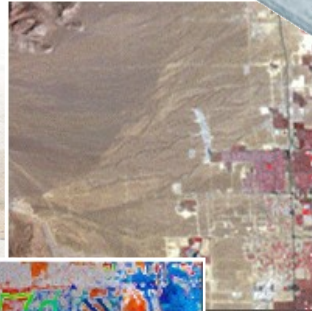






# ***Hard Problems*** Time Critical, Standoff, and Concealed Target Defeat

- ***Locate***
- ***Characterize***
- ***Defeat***
- ***Assess***



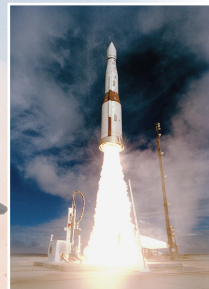
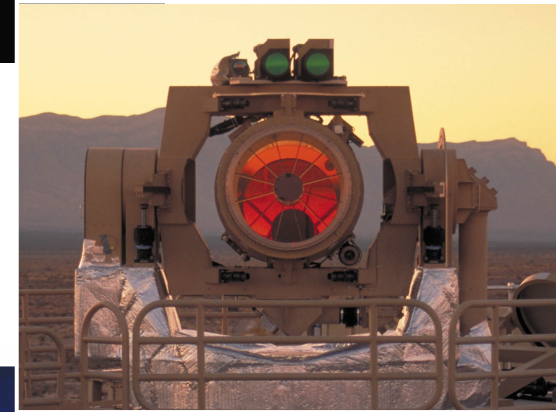
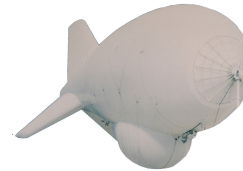
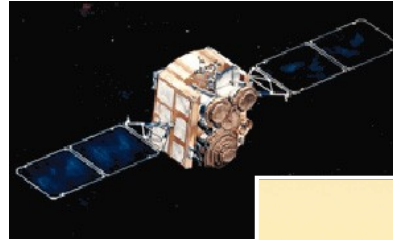
***Hardened and Deeply  
Buried Targets  
Slowly Moving  
Targets***

***Provides capability to safely identify and strike  
intended targets.***

# Cruise and Ballistic Missile Defense



- **Detect**
- **Track**
- **Negate**
- **Protect**



*Provides capability to remotely detect, track, and negate cruise and ballistic missile threats.*

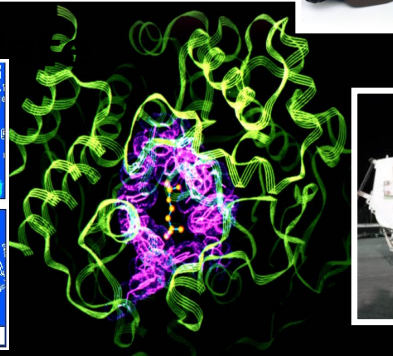
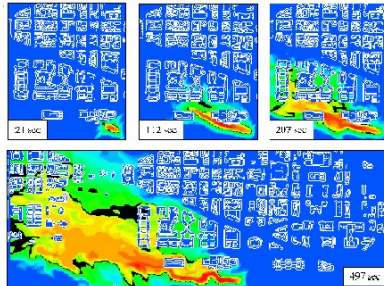




# ***Hard Problems***

## Chem-Bio Defense Modeling and Stand-off Detection

- ***Detect***
- ***Predict***
- ***Characterize agent toxicity***
- ***Determine genetic/chemical composition***
- ***Model & sim***

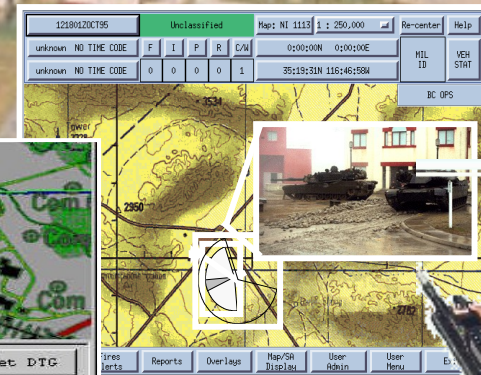
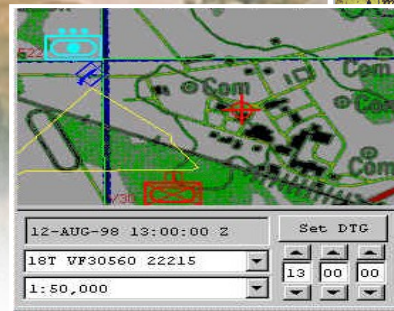


***Provides real-time capability to remotely detect chemical and biological agents and forecast their dispersion***

# Military Operations in Urban Terrain



- **Enhance understanding**
- **Improve training**
- **Expand mission rehearsal capabilities**
- **Provide fast, safe breaching capabilities**
- **Neutralize threat**



***Provides capability to engage threat forces in an urban environment.***



# Counters to <sup>Hard Problems</sup> Asymmetrical Threats



- **Understand unconventional threats**
- **Predict human behavior**
- **Develop decision support aids**
- **Dissuade**

***“Win without fighting”***

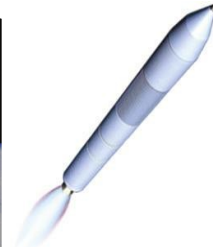
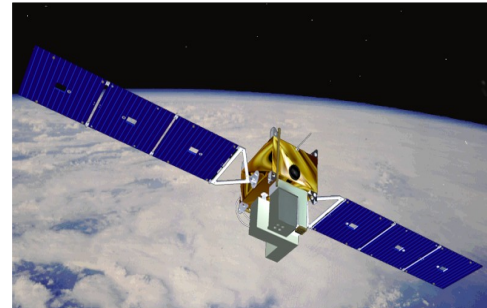
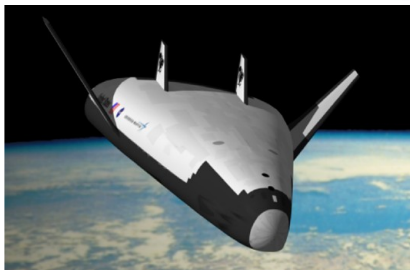


***Provides improved information operations, computational models, and social science theory to allow commander to shape engagement without force***

# Revolutionary Warfighting Concepts Fuller Dominance of Space



- ***Develop affordable space transportation***
- ***Assure space surveillance***
- ***Control space***
- ***Protect on-orbit assets***
- ***Apply force from space***



***Provides capability to fully exploit space,  
conducting operations at will.***



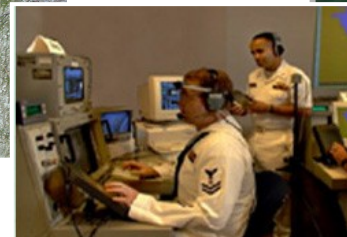
# Revolutionary Warfighting Concepts Network Centric Warfare



- **Develop robust connectivity and interoperability**
- **Provide information assurance**
- **Improve decision support**
- **Exploit high performance computing**



## Software Intensive Systems



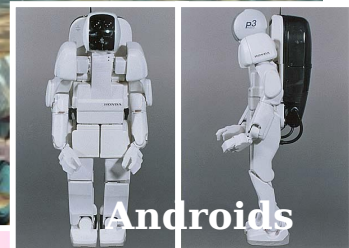
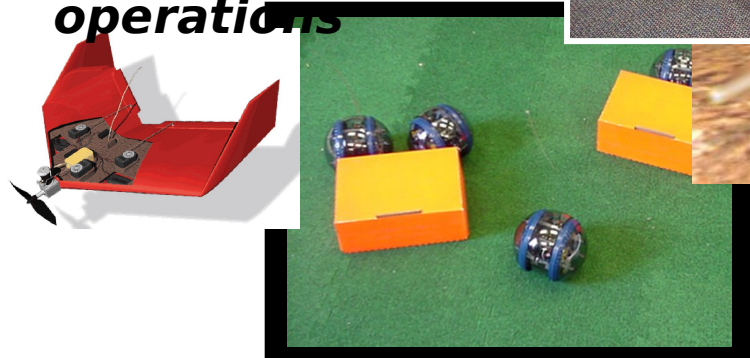
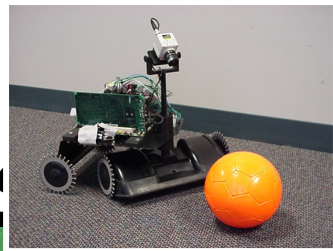
***Provides increased combat power by networking sensors, decision makers, and mission executors, to achieve shared awareness, self-synchronization, and improved operations***

# Revolutionary Warfighting Concepts

## Unmanned Systems for Land, Air, Sea, and Underwater



- **Control assets remotely**
- **Miniaturize components**
- **Integrate information**
- **Develop collective behavior**
- **Develop distributed operations**



Androids



Tactical UGV

*Provides capability to safely execute an expanded range of missions*



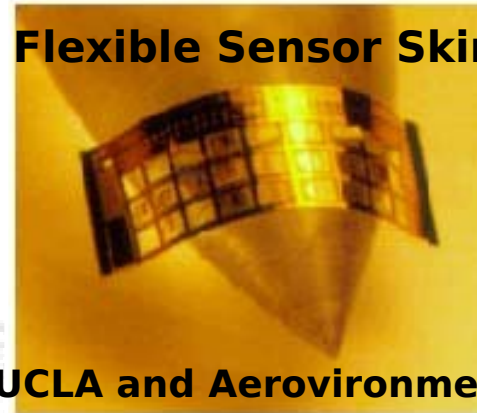
# *Militarily Significant Research Areas* Nanoscience and Advanced Materials



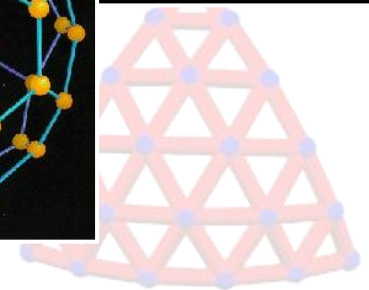
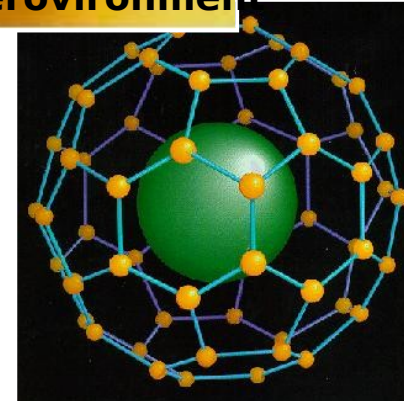
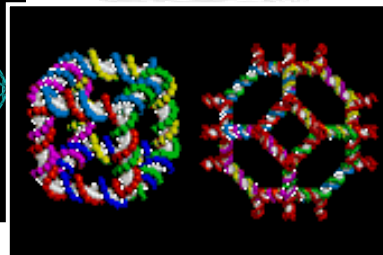
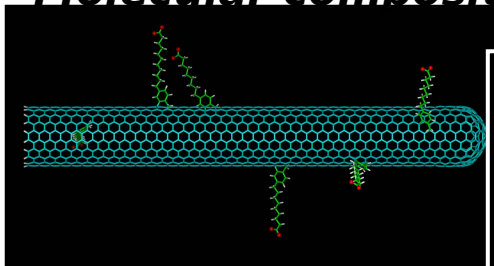
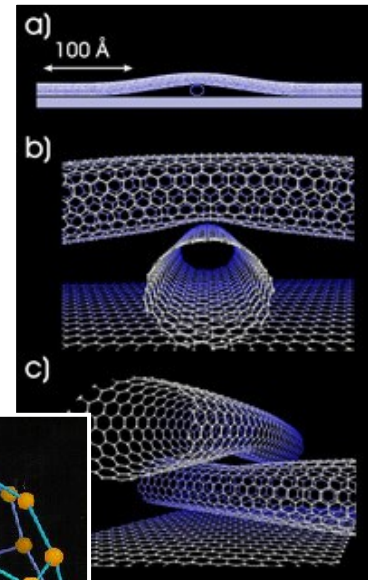
- **Exploit:**

- **Carbon computers**
- **Molecular engineering**
- **Nanoscale robots, sensors, machines**
- **Battery electrode and energy storage**
- **Vacuum microelectronics devices**
- **Molecular composites**

**Flexible Sensor Skin**



**UCLA and Aerovironment**

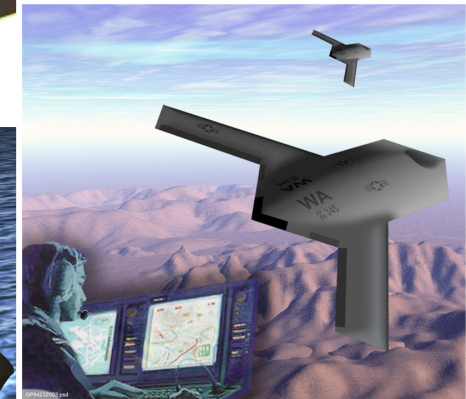
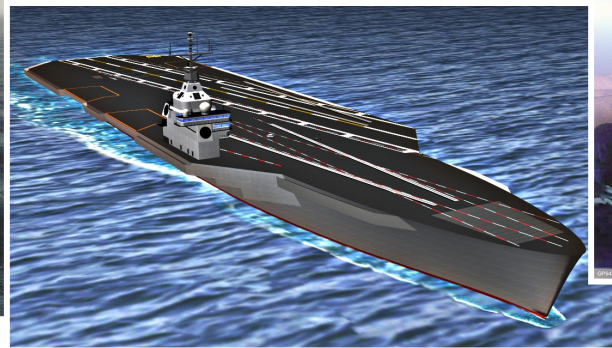


***Provides opportunity to develop totally new operational concepts and capabilities.***

# ***Militarily Significant Research Areas Advanced Power***



- ***Improve energy storage and release***
- ***Enhance power generation/distribution***
- ***Develop new power applications***
- ***Exploit electric drive***
- ***Enhance propulsion technologies***



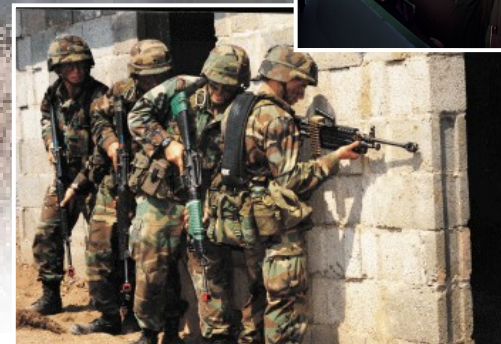
***Provides opportunity to more efficiently project a capability throughout the battlespace.***



# ***Militarily Significant Research Areas*** Human Dimension and Psychological Factors



- ***Improve training aids***
- ***Develop decision making skills***
- ***Improve cognitive readiness***
- ***Enhance performance***

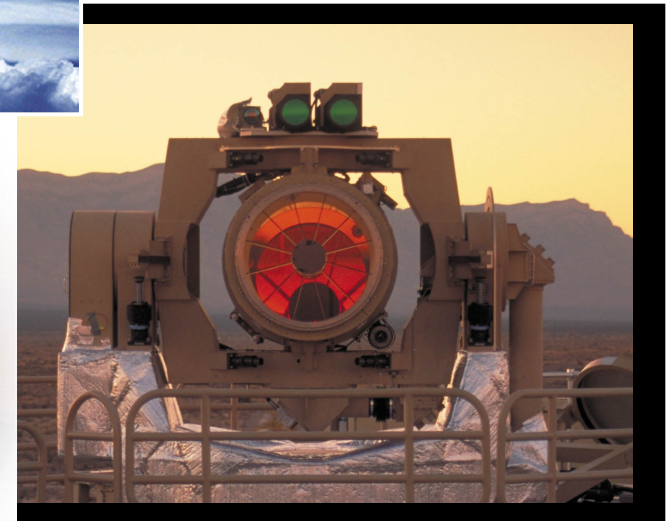
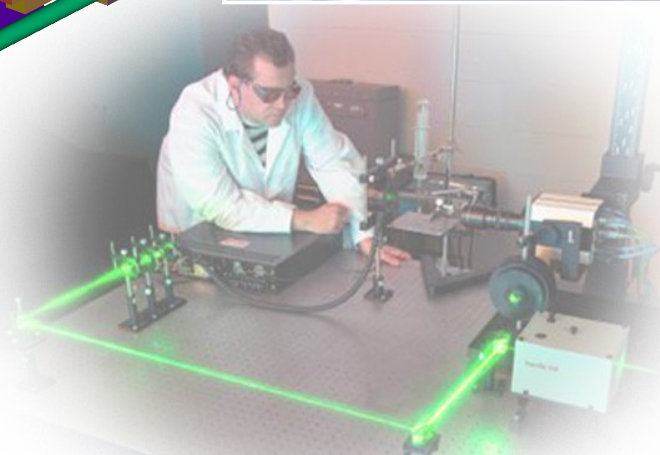
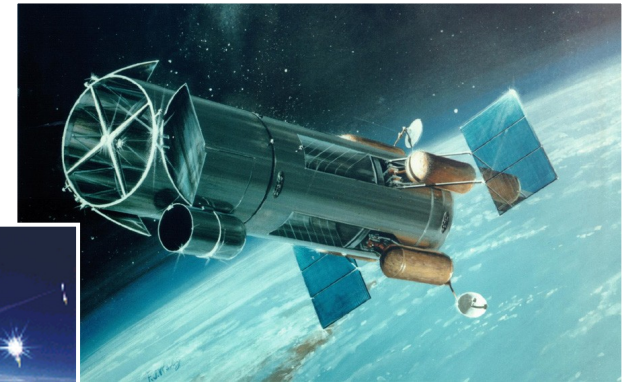
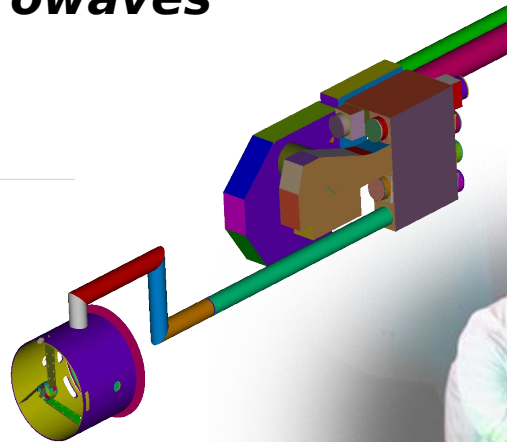


***Provides opportunity to improve human information recognition and retention.***

# Militarily Significant Research Areas Directed Energy



- **Exploit:**
- **High energy lasers**
- **High powered microwaves**



***Provides opportunity to revolutionize operations in traditional battlespace environments.***



# Defense Modeling & Simulation Office Vision



“**Lead** and **Integrate** the DoD M&S community, and **Leverage** M&S science and technology advances to ensure that the warfighters of today and tomorrow have superior and affordable M&S tools, products and capabilities to support their missions and to give them revolutionary war-  
*Lead, Integrate and Leverage M&S for the Warfighter*”



# Defense Modeling & Simulation Office Priorities



- **Joint Warfighter Requirements**
  - Support to CINCs & Services
  - Joint Program Support (JSIMS, JMASS, JWARS) & Integration
- **Enterprise Activities**
  - High Level Architecture Transition
  - Simulation Interoperability Standards
  - Synthetic Environment
- **Science & Technology Initiatives / Concepts Applications**
  - Human and Group Behavior
  - Simulation Based Acquisition
  - Technology Demonstration
- **Community Services & Coordination**
  - M&S Integration Task Force & DoD M&S Master Plan
  - M&S Information Analysis Center
  - M&S Resource Repository
  - Outreach



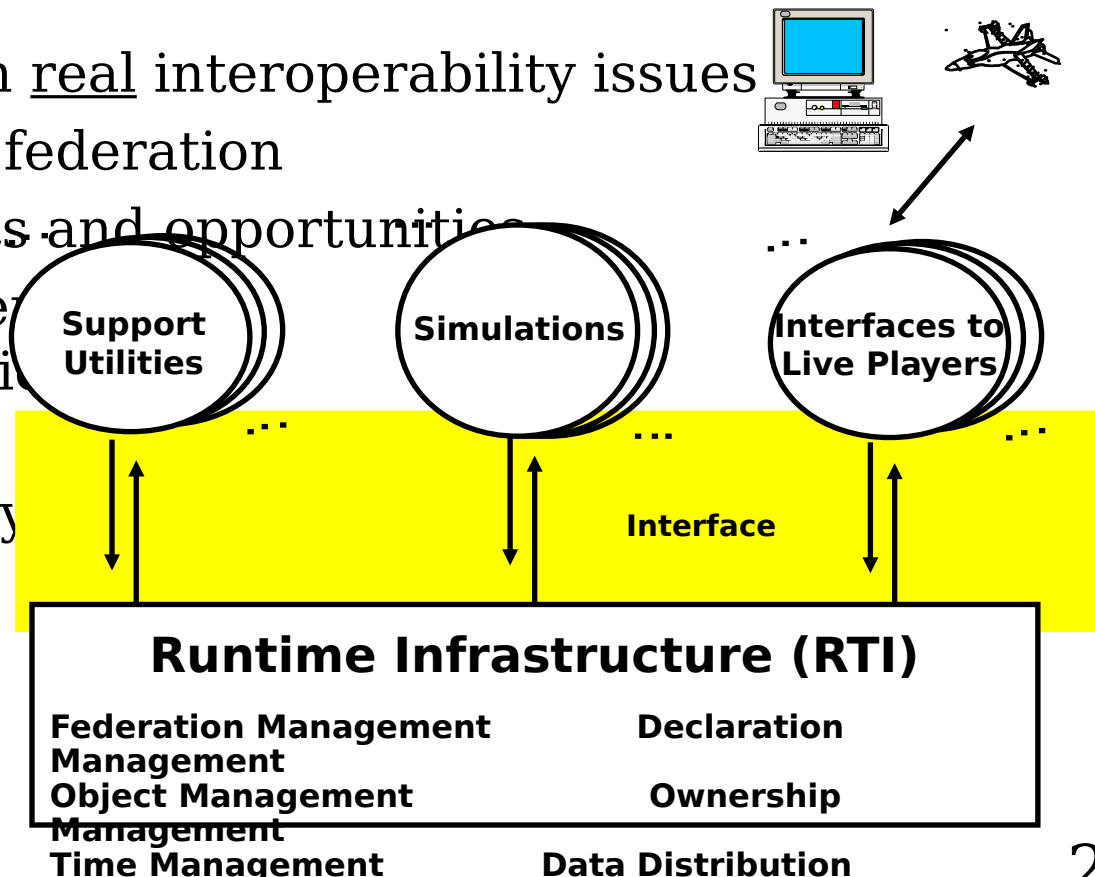


# *DMISO Accomplishment:* High Level Architecture (HLA)

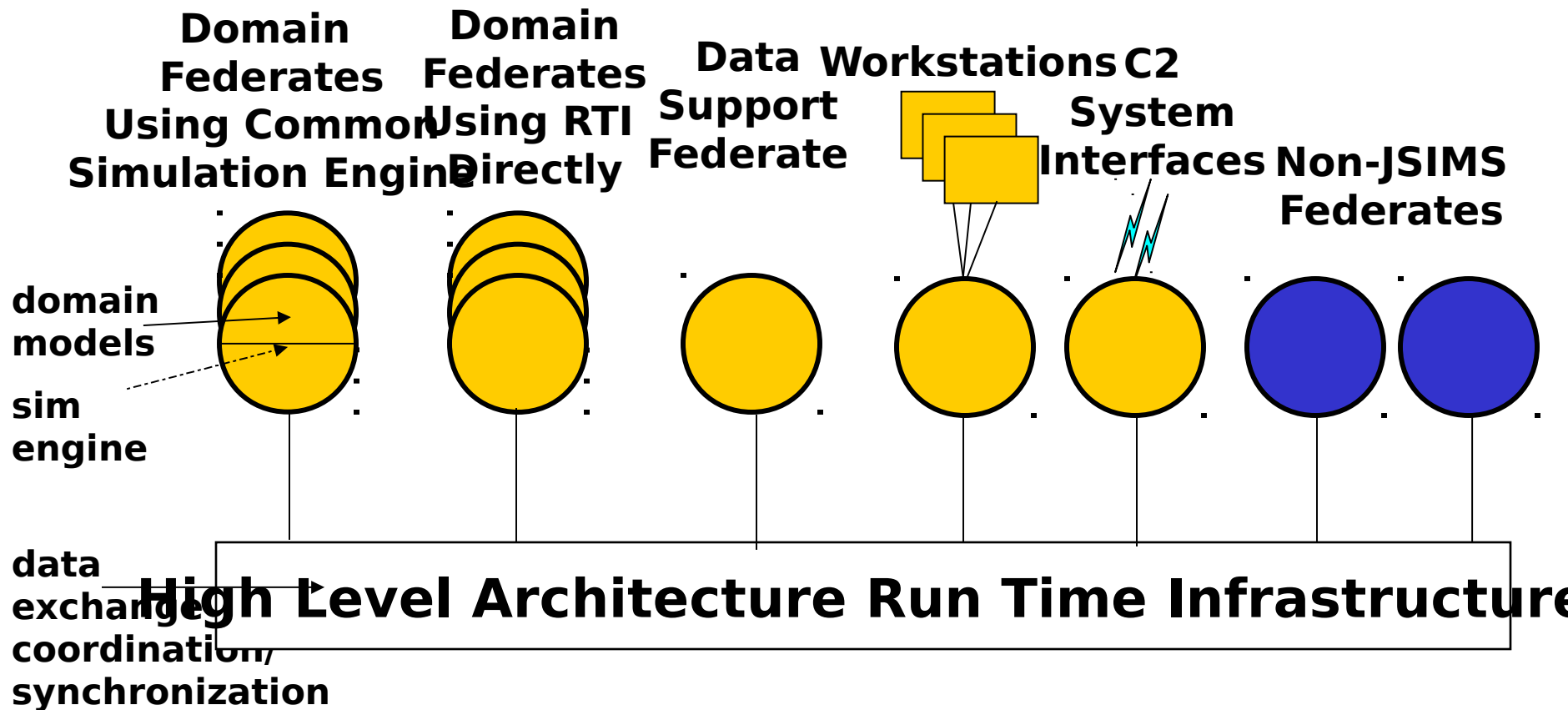


*HLA: technical architecture for interoperability and reuse - Nov 2000*

- IEEE standardization
- Focused community on real interoperability issues
- Enabled cross domain federation
- Created reuse products and opportunities
- Brought rigorous system engineering to federation development
- 60% to 80% community technology adoption (SEI study)



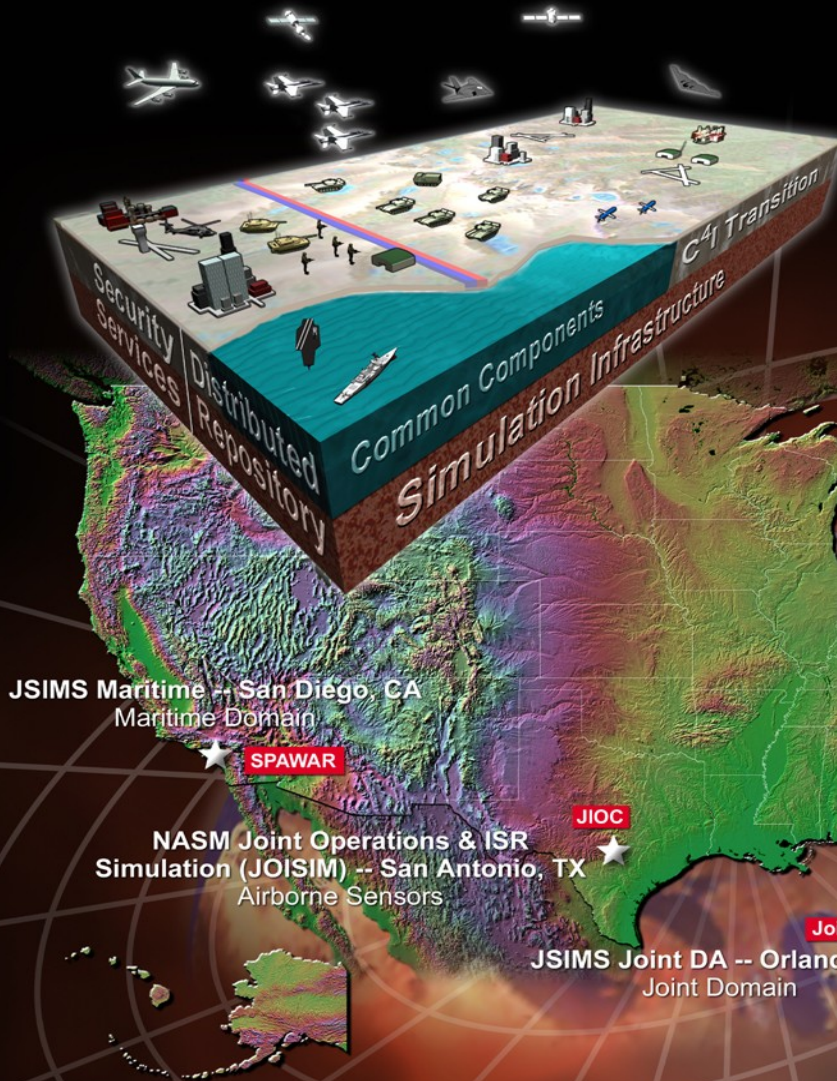
# Joint Simulation System (JSIMS)





# JOINT SIMULATION SYSTEM (JSIMS)

## JSIMS ALLIANCE ACROSS THE NATION



## MISSION

To provide...  
A computer-simulated environment...  
For use by CINCs, joint organizations, and the Services...  
To educate, train, and develop doctrine and tactics...  
For Joint warfighting and other operational needs.

**National Simulation (NATSIM) -- Reston, VA**  
National Intelligence Systems

**Joint SIGINT Simulation (J-SIGSIM) -- Columbia, MD**  
Signal Intelligence

**National Air and Space Model (NASM)**  
Hanscom AFB, MA  
Air and Space Domain

**NRO**  
**NSA**  
**DIA**

**DOMINO -- Bolling AFB, Wash, DC**  
DIA National Intel Process Modeling

**DMSO -- Alexandria, VA**  
High-Level Architecture

**MARCORSYSCOM**

**USMC DA -- Orlando, FL**  
USMC Requirements

**STRICOM**  
**Warfighters' Simulation (WARSIM) -- Orlando, FL**  
Land Domain

**WARSIM Intelligence Module (WIM) -- Orlando, FL**  
Tactical Intelligence

**JSIMS Maritime -- San Diego, CA**  
Maritime Domain

**SPAWAR**

**NASM Joint Operations & ISR  
Simulation (JOISIM) -- San Antonio, TX**  
Airborne Sensors

**JIIOC**

**JSIMS Joint DA -- Orlando, FL**  
Joint Domain

**Joint**



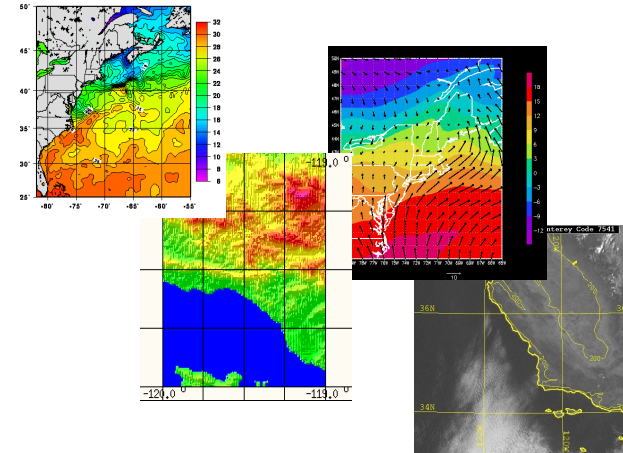
# *DMSO Accomplishment:* Integrated Natural Environment Program



*Provides the  
warfighter  
integrated  
authoritative  
representations*



*Effect of high winds on  
concealment smoke changed  
outcome of the battle.*



*Environmental data from  
the various domains*

- Released SEDRIS Interoperability Standards and software tools
- SEDRIS specified in acquisition of Army, Joint, and NATO systems
- Demonstrated use of dynamic run-time natural environment

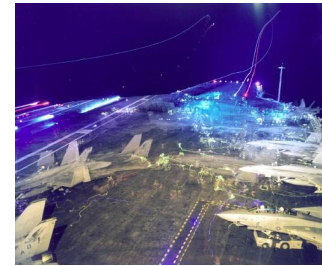
# Current DMSO Focus: Human Behavior Representation



**Training**



**Systems Analysis** **Command Decision Aiding**

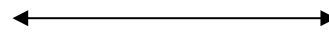


**System Acquisition**

Individuals



Teams



Organizations

**Human Behavior represented within M&S:**

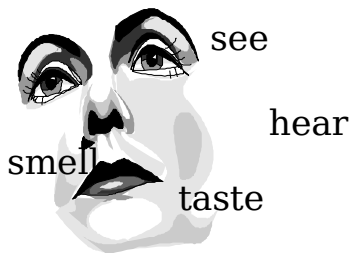
*Sensing & Perception*

*Physical Movement*

*Information Processing*

*Decision Making*

*Communication & Coordination*



**Vision:** To enhance warfighter decisions by enabling valid models using credible data that reflect realistic human behavior



# *DMSO Accomplishment:* Service Academy Outreach



- **M&S laboratories enhanced at all three Academies**
- **Summer interns (6 to 10 per Academy)**
- **Visiting M&S professors**
- **Doubled simulation-based training at Academies**





# S&T Requires Strong Partnerships

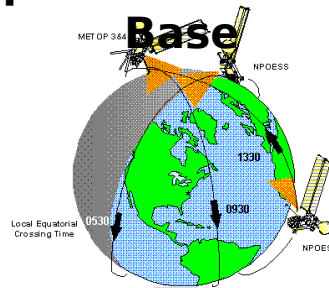


**Link to the Warfighter**



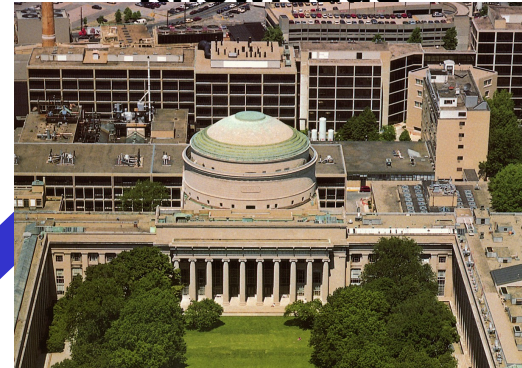
**Service Labs**

**Expanded Resource Base**



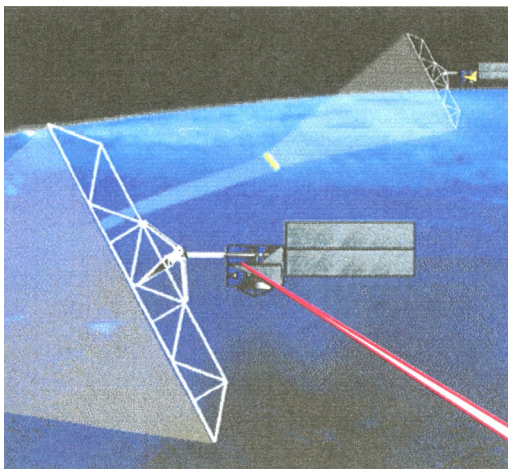
**Interagency**

**New Ideas, Knowledge**



**Universities**

**DARPA**



**High Risk, High Payoff**

**Maximum National Security Payoff**

**International**



**Coalition Capability**

**Industries**



**Innovation, Transition**



# *A Focus on Tomorrow's Possibilities*



**T**echnical Superiority is  
Critical for National Security.

In peace, it provides deterrence;

In crisis, it provides options;

In war, it provides an edge."

*Defense Science and Technology Strategy*  
May 2000

